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Vehicle suspension device comprising an elastic joint with adjustment means

The invention relates to automobile vehicle axles comprising suspension devices having an elastic elastomer joint.

Elastic elastomer joints can be used to ensure the "spring" function between the vehicle chassis and the wheel. It is known in particular from EP 0 956 954 that these elastic elastomer joints may contribute substantially if not totally to absorbing the load of the vehicle chassis by ensuring a spring suspension function subjected to torsional stress. The specification EP 1 090 783 proposes to solve the problems associated with such elastic joints, in particular to limit the drift of the chassis height due to torsional stress of the elastic elastomer joint. To this end, EP 1 090 783 proposes a method of stabilising the mechanical properties of operation of an elastic elastomer joint by subjecting this joint to maximum deformation corresponding to a maximum compression limit deformation corresponding to a maximum compression deformation when the joint is installed on the vehicle. Thus these elastic elastomer joints need, in order to ensure good retention of their properties over the course of time, to undergo an operation of adjustment before being mounted on the vehicle.

Hitherto, after the mounting of the axle on one hand on the vehicle chassis and on the other hand on the wheel, there often appears to be an unacceptable variation in actual height of the vehicle chassis relative to a nominal height due to the variation both in the mass of the vehicle and in the properties, in particular rigidity, of the elastomer material according to the batches from which this material originates.

The invention has just improved the situation.

The invention relates to an elastic elastomer joint adapted to act as a spring member of a vehicle suspension device, the joint defining an axis of rotation Y and comprising an inner reinforcement and an outer reinforcement connected

by an elastic elastomer material. The joint is adapted to be fixed on the one hand via the outer reinforcement to a longitudinal oscillating arm connected to the shaft of a vehicle wheel and on the other hand via the inner reinforcement to the vehicle chassis and in order to counter a torsional restoring force when subjected to a torsional force in the axis Y.

According to a main feature of the invention, the outer reinforcement comprises means of adjusting the angle of the joint about the axis of rotation Y relative to the longitudinal oscillating arm.

Advantageously, the angular adjustment means extend radially from the periphery of the outer reinforcement.

In a preferred embodiment of the invention, the angular adjustment means comprise at least one elongate hole in the form of an arc of a circle centred on the Y axis adapted to be positioned in line with a hole in the longitudinal oscillating arm in order to fix the joint to the longitudinal oscillating arm.

In another preferred embodiment of the invention, the angular adjustment means comprise at least one elongate hole with notches in the form of an arc of a circle centred on the axis Y.

Preferably, the angular adjustment means comprise at least two lugs extending radially over the periphery of the outer reinforcement and each comprising a elongate hole.

In a modification of the invention, the angular adjustment means comprise at least two holes, one corresponding to a hole in the longitudinal oscillating arm for a specified angular position of the longitudinal oscillating arm relative to the axis of rotation Y, the other hole corresponding to another hole in the longitudinal oscillating arm for another specified angular position of the longitudinal oscillating arm relative to the axis of rotation Y.

Preferably, the angular adjustment means comprise at least two lugs extending radially from the periphery of the outer reinforcement and each comprising at least the two holes.

The Figures below illustrate in a non-limiting manner embodiments of the invention:

Figure 1 shows an elastic elastomer joint according to a first embodiment of the invention;

Figure 2 shows an elastic elastomer joint under stabilising torsional stress and clampd with a clamping device according to Fig. 1;

Figure 3 shows a view in section of the clampd elastic elastomer joint of Figure 2;

Figure 4 shows an elastic elastomer joint under stabilising torsional stress and clampd with a clamping device according to a second embodiment of the invention;

Figure 5 shows the elastic elastomer joint according to Figure 4 in a side view;

Figure 6 shows an elastic elastomer joint under stabilising torsional stress and clampd with a clamping device according to a third embodiment of the invention;

Figure 7 shows the elastic elastomer joint according to Figure 6 in a side view;

Figure 8 shows an elastic elastomer joint under stabilising torsional stress and clampd with a clamping device according to a fourth embodiment of the invention;

Figure 9 shows the elastic elastomer joint according to Figure 8 in a side view;

Figure 10 shows an elastic elastomer joint comprising an adjustment device according to a first embodiment of the invention;

Figure 11 shows an elastic elastomer joint comprising an adjustment device according to a second embodiment of the invention;

Figure 12 shows an elastic elastomer joint comprising an adjustment device according to a third embodiment of the invention;

Figure 13 shows a view from below of an elastic elastomer joint comprising an adjustment device according to one of Figures 10 to 12;

Figure 14 shows an axle comprising an elastic elastomer joint.

The drawings contain essentially elements of a definite nature, and may therefore not only help to explain the description, but also contribute to the definition of the invention if necessary.

In Figure 1, the elastic elastomer joint 1 is free of any torsional stress. It is formed of a tubular inner reinforcement 2 of circular section surrounded by an elastic sleeve 6, e.g. of the rubber type, itself surrounded by a tubular outer reinforcement 4 of circular section. The outer reinforcement 4 comprises a stop 8 projecting outwards, e.g. in the form of a hook.

When the elastomer material is subjected to a torsional stress C_T, known as stabilising stress, the inner reinforcement and the outer reinforcement rotate relative to one another about the axis Y (following the direction of rotation indicated by the arrow A and the reverse direction). Before release of the torsional stress, a clamping element is fixed to the inner reinforcement 2 and

extends from the inner reinforcement 2 to the outer reinforcement 4 and comprises a part adapted to come into contact with the stop 8 of the outer reinforcement 4.

Figure 3 shows more particularly the shape of the clamping element. This clamping element is formed of a rod 10 bent into a general U-shape comprising two columns 12 connected together by a crosspiece 14. Before release of the torsional stress, one column 12 is fixed to each end of the inner reinforcement projecting axially from the sleeve 6 and from the outer reinforcement 4. The columns 12 are fixed to the inner reinforcement in holes 16 for example. In the non-limiting example of Figure 3, these columns 12 are fixed opposite one another and extend radially so as to extend slightly beyond the outer reinforcement so that the crosspiece 14 can slide over the periphery of the outer reinforcement 4. After release of the torsional stress, the restoring torsional torque C_R of the elastomer material brings the crosspiece and the stop 8 into mutual abutment as is shown according to Figure 2.

The clamping element is not limited to a rod bent into a U-shaped profile. Thus the clamping element could be realised in any other form that allows bearing in abutment at the outer reinforcement.

Figures 4 and 5 show a second embodiment according to the invention of a clamping device.

The elastic elastomer joint 1 comprises a yoke 22 for fixing the axle to the vehicle chassis and a clamping device formed of a clamping element.

The fixing yoke 22 is formed, as is indicated in Figure 5, of a single moulded part bent into a general U-shape. This bent part is formed of two parts forming columns 30, respectively coming into contact with the two axial ends of the inner reinforcement 2. These two parts 30 are connected to the inner reinforcement by a fixing mechanism, e.g. a nut and bolt 26 and washers 28.

The two parts forming columns 30 extend radially so as to go beyond the outer reinforcement and are connected together by a part forming a crosspiece 21 parallel to the axis of rotation Y of the joint. The part forming a crosspiece 21 is curved in the direction of the outer reinforcement on an edge parallel to the axis of rotation Y, so as to form a concavity 24. This concavity 24 is intended to receive one side of a clamping element, e.g. one side of a rectangular clamping plate 20. The opposite side of this clamping plate is placed so as to come to bear on the stop 8 of the outer reinforcement 4 once the elastomer material is placed under tensile stress. The clamping element is subjected to opposite compression forces exerted on the one hand by the stop 8 and on the other hand by the crosspiece 21. These compression forces are the result of the restoring torque to which the elastomer material is subjected. In one embodiment of the invention, the length of the clamping element is selected to apply a desired tension (or restoring) torque to the elastomer sleeve.

Figures 6 and 7 show a third embodiment according to the invention.

In this embodiment, the clamping device is formed of the fixing yoke 22 and of a clamping element.

The fixing yoke 22 is of the same general shape as the fixing yoke in Figures 4 and 5. The fixing yoke 22 of Figures 6 and 7 further comprises, at the part forming a crosspiece 21, an element forming a hook 32 parallel to the axis of rotation Y. This element 32 is formed, in the embodiment of Figures 6 and 7, of a cut-out in the part forming a crosspiece 21, then by bending in the direction of the outer reinforcement. On the other hand, the outer reinforcement 4 comprises a stop 8 according to the preceding embodiments and a cam 9 which are slightly staggered in the circumferential direction.

The clamping element 34 is formed, as Figures 6 and 7 show, by a rectangular plate curved on one side and having the general shape of an S on the other

side. This plate is intended to hook on one side on to the stop 8 of the outer reinforcement 4 and on the other side to the element forming a hook 32.

As above, this clamping element is installed once the elastic elastomer joint is under a torsional stress and its length depends on the value of torsional stress (or restoring force) selected, as is described above.

The restoring torque exerted on the elastic elastomer joint makes it possible to keep the clamping element bearing on the one hand on the stop 8 of the outer reinforcement and on the other hand on the element forming a hook 32 of the plate 21. Indeed, the clamping element is subjected to opposite tensile forces exerted on the one hand by the stop 8 on a curved side of the plate and on the other hand by the element forming a hook 32 on the other curved side.

Figures 8 and 9 show a fourth embodiment of the invention.

As above, the clamping device is formed of the fixing yoke 22 and of a clamping element 36. The fixing yoke 22 is of the same general shape as the fixing yoke in Figures 4 and 5.

This time, the clamping element 36 is a cylindrical rod known as a clamping "circle". The fixing yoke comprises a notch 38 on one edge of each part forming a column 30, these two notches being opposite one another parallel to the axis of rotation Y. These notches 38 are placed radially slightly beyond the radius of the outer reinforcement so that the clamping circle 36 abuts the stop 8 of the outer reinforcement. In other words, the notch is located so as to come opposite the stop 8 when the elastomer material is subjected to stress.

Thus the clamping element 36 is held in the notches 38 of the plates by the thrust of the stop 8 of the outer reinforcement. Indeed, the clamping element 36 is held on the one hand in the notches 38 and on the other hand against the stop 8 by the restoring torque exerted on the elastomer material.

Obviously, other forms of clamping could be developed according to the invention. Thus other clamping elements could be used.

The elastic elastomer joint forms part of a suspension device for mounting on a vehicle. In the embodiments of Figures 1 to 9, the clamping elements such as the clamping rod 10, the clamping plate 20, the clamping plate in a general S-shape 34, and the clamping circle 36 are clamping elements positioned after the elastic elastomer material has been placed under stabilising torsional stress and are kept fixed to the elastic joint by the restoring torque exerted on the elastomer material. These clamping elements are automatically released from their abutment against the stop 8 of the outer reinforcement once the suspension device is mounted on the vehicle and once the vehicle is bearing on the ground with its wheels. Indeed, the elastic joint is then subjected to an inverse torsional stress of the restoring torque. Their release requires no particular operation since the torsional torque exerted is of the same sign as the stabilising torsional torque and is greater than or equal to the stabilising torsional torque in absolute value. Moreover, the elastic joint is mounted on the suspension device, itself mounted on the vehicle, in such a manner that, under the inverse torsional stress of the restoring torque, the clamping elements are released and restored automatically by gravity.

Thus, due to the position of the centre of gravity of the rod 10 substantially to the vertical below holes in the inner reinforcement, the clamping rod 10 is released from the holes of the inner reinforcement and from its bearing on the stop 8; the clamping plate 20 is released from the concavity 24 and from its bearing on the stop 8; the clamping circle 36 is released from the notches 38 and from its bearing on the stop 8; and one side of the clamping plate having a general S-shape 34 is released from its bearing on the stop 8 and the other side remains hooked to the element forming a hook 32. The side of the clamping plate 34 released from its bearing on the stop 8 describes the cam path governed by the cam 9 when the outer reinforcement is subjected to an inverse

torsional stress of the restoring torque. The thrust exerted by the cam on this side of the clamping plate permits unhooking of the other side of the clamping plate 34.

Figures 10 to 14 propose a device for adjusting the position, which can be combined or otherwise with the embodiments of Figures 1 to 9. In the non-limiting examples of Figures 10 to 13, it has been chosen to keep the embodiment of Fig. 2 so as to emphasise the possible complementarity of the embodiments of Figures 1 to 9 with the embodiments of Figures 10 to 13.

When the elastic elastomer joint has been subjected to torsional stress according to the possible embodiments of Figures 1 to 9, the mounting of this elastic joint on the rest of the axle, then mounting of the axle on the chassis of the vehicle on the one side and on the shaft of a wheel of the vehicle on the other does not make it possible to be sure of the actual height of the vehicle chassis and/or of its horizontality.

The invention proposes in particular a device for adjustment at the elastic joint.

When a torsional stress is applied to the elastic elastomer joint as shown in Figures 1 to 9, a rigidity curve of the elastic joint is established. This rigidity curve associated with the actual mass of the vehicle makes it possible to adjust the position of the elastic joint relative to the other elements of the axle by virtue of the adjustment device according to the invention. The height of the vehicle chassis can thus be selected before mounting of the axle on the vehicle and be obtained by pre-adjustment before mounting of the axle on the vehicle. All vehicles can thus have the same actual height, whatever their mass and the joints that they comprise.

On the other hand, this adjustment device also permits retrospective adjustment if an error is made or if the vehicle has a mass that does not match the expected mass.

According to Fig. 10, the elastic elastomer joint comprises an inner reinforcement 2, an elastomer material sleeve 6 and an outer reinforcement 4 already described with respect to Figures 1 to 3. Furthermore, the outer reinforcement 4 has an angular adjustment device 41 intended to connect the elastic joint 1 to a support element of the wheel of a vehicle, this element being referred to hereinafter as "longitudinal oscillating arm".

The longitudinal oscillating arm, which may be a tube of rectangular section, comprises two mutually parallel sides machined in an arc of a circle so that the outer reinforcement can be encased in these arcs of a circle. Moreover, at least one side has two holes 42 positioned beyond the arc of a circle.

The angular adjustment device 41 comprises two lugs 44 extending radially over the periphery of the outer reinforcement. These two lugs 44 move apart from one another by rotating about the axis Y. These two lugs 44 each comprise an elongate hole 46 in the form of an arc of a circle. Thus the longitudinal oscillating arm is first connected to the elastic joint by inserting bolts, passing through the holes 42, into the elongate holes 46. Each bolt may describe the path defined by the corresponding elongate hole. The longitudinal oscillating arm can thus rotate about the axis of rotation Y by an angle α defined by the length of the elongate holes. Once the longitudinal oscillating arm is adjusted in rotation, this is fixed to the elastic joint 1 by nuts cooperating with the bolts.

Another embodiment of the angular adjustment device is shown in Figure 11. The longitudinal oscillating arm has the general shape described according to Figure 10.

Thus, the elongate holes in the form of an arc of a circle of the angular adjustment device of Figure 10 are replaced by elongate holes with notches 48 disposed in an arc of a circle. In the example of Figure 11, two notches make it

possible to define three positions for the fixing hole 42 of the longitudinal oscillating arm 40.

In a third embodiment according to Figure 12, the angular adjustment device comprises two lugs 44, each pierced by a set of holes, e.g. three lug holes 51, 53, 55 staggered. On the other hand, the longitudinal oscillating arm 40 is of the general shape described according to Figure 10. The two holes in the arms described above are replaced by two sets of holes of arms each formed of a certain number of holes, in the example three holes 50, 52, 54 of the arm, staggered. When the longitudinal oscillating arm is positioned against the outer reinforcement whilst remaining rotatable relative to the axis of rotation Y, one hole of each lug 44 is placed over a hole of the set of holes of the corresponding arm, e.g. the hole 55 adapting to the hole 54. The other lug holes are not superimposed over the arm holes in this specified angular position of the longitudinal oscillating arm relative to the axis of rotation Y. In order to place another hole of each lug over another hole of the corresponding set of arm holes, the position of the longitudinal oscillating arm must be modified by rotation about the axis Y. The same applies to the last hole of each lug to be placed over the last hole of corresponding set of arm holes. Between a first hole of the set of arm holes placed over a first hole of the set of lug holes and a last hole of the set of arm holes placed over a last hole of the set of lug holes, the longitudinal oscillating arm pivots by an angle α centred on the axis Y. This system is known as a system with staggered holes.

Figure 13 shows the elastic joint 1 fixed according to the invention to the longitudinal oscillating arm 40 by a nut and bolt system 62 through a hole of the angular adjustment device 41 such as those in Figures 10 to 12. On the other hand, the elastic joint 1 is fixed to the fixing yoke 22 comprising four holes 60 over its upper plate 21 intended to permit the passage of fixing means to the vehicle chassis.

The angular adjustment device is not limited to the various embodiments shown, and could be conceived according to modified embodiments.

Figure 14 is located in a plane P (drawing plane) perpendicular to the axis Y. The plane P' defines the plane of contact between the vehicle chassis and the fixing yoke 22, the plane P' being parallel to the axis Y. The angular adjustment device makes it possible to adjust the angle β located in the plane P and defined by the dihedral formed by the plane P' and the plane R passing through the axis Y and the axis of the wheel 70. This angle β, obtained during assembly of the elements of the axle before mounting on the vehicle, can be selected so that, once the unit 22, 1 and 40 has been mounted on the vehicle, this angle is close to a value such that the vehicle chassis has a specified height. This angle may in particular be selected from the knowledge of data concerning the rigidity of the elastic joint associated with the actual mass of the vehicle. These data can be presented in the form of a rigidity curve of the elastic joint as a function of the vehicle mass. In the case of a prior adjustment of the elastic joint (or subjection to torsion), this curve may be obtained during this operation by testing at different torsional torque values.

The height of the vehicle chassis may thus be selected before mounting of the unit 22, 1 and 40 on the vehicle and may be obtained by pre-adjustment before mounting of the axle on the vehicle.

On the other hand, this adjustment may also be used after mounting of the unit 22, 1 and 40 on the vehicle chassis. This adjustment is known as "post-mounting adjustment".

The invention is not limited only to the embodiments described. It will be obvious to the person skilled in the art that the invention can extend to may other modifications.

Thus the angular adjustment device on the elastic joint is described in correspondence with an elastic joint having been subjected to stress as described in Figures 1 to 9. However, this angular adjustment device on the elastic joint forms an invention in itself which can be implemented separately.